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Using Electronic Courses in Teaching Master's Degree Students

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Abstract

The paper discusses the structure, design peculiarities and usage methodology of an electronic course in learning management system Moodle. Blended learning combines the technologies of traditional classroom-based and web-based learning, which complement each other. The blended learning model implies replacing a part of traditional classes with different types of educational interaction in a virtual learning environment. The Department of Power Grids and Electrical Engineering of Tomsk Polytechnic University is developing electronic training complexes for master's degree disciplines, such as Operational Management in Power Engineering and Methods of Stability Calculation. The paper shows the applicability of electronic courses as a tool for developing professional competencies in students.

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Keywords: Moodle; electronic training complex; electronic course; blended learning.

1. Introduction

The modern professional environment is constantly changing for the graduates of power engineering specialties. This calls for the need in updating the requirements to their professional competencies, which affects the choice of educational technologies (Fix, 2015).

There is an abundance of electronic courses in various disciplines created in different virtual learning environments (Brinson & James, 2015; Broadbent & Poon, 2015), but we did not manage to find any analogs for master's degree disciplines associated with operational dispatch management in power systems. Therefore, it is of

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great current interest to describe the principles of design, structure, functional purpose, and usage methodology of an electronic course in the teaching process with modern simulators used for professional training of operating personnel.

2. Tool Kit for Electronic Courses

For developing electronic courses, we chose learning management system (LMS) Moodle as a virtual learning environment, which allows us to create editable and manageable electronic training materials (Caputi & Garrido, 2015; Gogan, et al., 2015).

Moodle is a learning management system that makes it possible for a teacher to create their own website filled with dynamic courses, which allow students to learn at any time and any place convenient for them. Moodle includes the following features:

- uploading files of various formats created in external software
- developing training materials within the environment with the help of an embedded HTML editor
- monitoring the learning process by means of tests, tasks, seminars, wiki, forums and other tools
- communication within the course by means of forums, chats, and webinars; feedback through surveys and questionnaires (Tunda, 2014).

We use Fenix and Finist operator training simulators as tools for designing and implementing business games devoted to power system state management and Modus switching training simulators for the games involving switching operations.

3. Methodological Support and Implementation

The training philosophy can be viewed as recommendations on how to choose ways of achieving teaching goals with due consideration of regularities and conditions of the educational process, which can be made effective through optimal combinations and interaction of its elements. Therefore, when designing electronic courses, one should take into account a system of requirements to them as teaching tools and software products.

The Department of Power Grids and Electrical Engineering of Tomsk Polytechnic University is developing electronic courses for a professional set of master's degree disciplines. The main goal of creating and using an electronic course is to develop professional competencies in a virtual learning environment. An electronic course must take into account didactic, psychological, methodological and ergonomic requirements to e-learning resources. (Fix & Troschinskiy, 2015a).

When using an e-learning system, we deal with the following main tasks:

- developing the structure of an electronic course in accordance with the syllabus of the discipline
- adapting the theoretical materials, practical and laboratory courseware as well as business games to the virtual environment
- arranging the classroom and independent work for students by means of Moodle

Due to a dramatic upsurge in the intensity and consciousness of learning, it is becoming ever more important to manage the learning process so that we could help a student, who is free to choose a training sequence and learning organization methods, select rational trajectories of mastering a discipline in the constructivism-based environment of Moodle (Tunda, 2014). We can adjust the duration and number of repetitions of the instructional impacts in an electronic course to fit the individual learning style of a student, thus providing intelligibility and individualization of learning.

At the same time, in order to prevent education from becoming fragmentary, we need to provide learning consistency by developing the expertise, knowledge and skills in the correct order, as part of a system where all the elements of a training course are logically related to each other (Babanskiy, 1989).

Moodle makes it possible to implement a deductive approach to presenting educational materials as enlarged modules, while being able to optimally use inductive educational methods as well.

Problem-based learning stimulates the intellectual activity of a student. At the same time, it is inadvisable and impossible to present all the training tasks in the form of problem situations (Lerner, 1974).

An electronic course must enable a learner to not only pursue theoretical conceptual thinking but also develop theoretical, practical and visual active thinking, broaden their mind, have access to world information resources and encourage intellectual and personal development.

Methodological recommendations to an electronic course depend on the discipline it contains. T. V. Kudryavtsev (1975) notes that the structure of technical notions stems from the properties, functions and relations between technical objects. The objectives of developing knowledge and teaching how to use it are time-related, since technical notions have an applied nature.

Engineering thinking is a combination of theoretical and practical activities. At the same time, the solution of engineering problems may require operating a complex dynamic system of images. The interaction of images and concepts is necessary to successfully deal with an engineering problem. In this sense, engineering thinking is both conceptual and visual by nature. Engineering material is usually presented in visual and abstract forms. Many production engineering problems require a solution within a limited time-frame and imply the use of probabilistic methods and selection of an optimal decision.

Thus, since operational engineering thinking has a conceptual, visual and practical structure, the instructional impacts of an electronic course must activate the conceptual, active and visual components of thinking.

We include the following major parts in the electronic course:

- electronic course book for independent study of theoretical materials
- laboratory course with a laboratory operations manual and business game guides
- learning outcome control module
- glossary
- links to additional resources

Each unit of the electronic course Operational Management in Power Engineering (Fix, 2015) includes theoretical materials created using the Moodle tools of Book and Lecture as well as tasks and tests. The corresponding units contain tasks and guidelines to laboratory work in the form of business games. Multimedia materials are, among other things, designed for demonstrating the switching operations in power systems (Fix & Troschinskiy, 2015b). Course objectives are training students in knowledge of technical processes, circuits, power engineering equipment, understanding of technical processes, knowledge of operational code for electrical installations, knowledge of electrical safety rules, obtaining skills of power management of electrical power network.

Laboratory works within the electronic course of Operational Management in Power Engineering are presented in the form of business games. Particularly, a business game devoted to switching operations involves students playing the following roles: dispatcher of a district power system control center, attendant electrician of a substation, and a controlling person. The participants receive information on the initial condition of the scheme, switchgear response and protective relays.

The preparation procedure for a business game devoted to the power system state management includes the following stages (Merkuriev, 2002):

- The instructor prepares a business game using a system of basic data preparation and carries out educational or test sessions. One or several intermediaries can be involved in carrying out this business game if necessary. This allows the instructor to concentrate on controlling the operating personnel's actions.
- The instructor directs the game course. He plays the role of the power system management and at the same time, together with the intermediary, performs functions of the personnel subordinated to dispatchers, imitating reception and execution of dispatchers' commands in power system objects. The corresponding controlling

actions are entered into the power system model: switching changes distributing gear layout; changes in the controlled parameters.
- For better session management the instructor has an opportunity to receive additional information: to display the detailed electric mode of the separate power system buses; to look through the list of events set in the training scenario showing completed and pending events; to look through emergency control system messages.

The evaluation system of the participants' activity must contain a list of actions to be marked and their quantitative indices. These may be points added or subtracted for standard and non-standard actions of the participants at each stage of the game. This system must be associated with a specific exercise at the development stage, when the recommended actions are determined. As a rule, the systems marks error actions, necessary decisions, imperfection of decisions, and various management trajectories. The main form of testing the knowledge and practical skills of the operational personnel are emergency response drills. The participant's efficiency in the course of eliminating an emergency is usually compared to a reference value determined by experts. The system can evaluate the quality of training participants' actions judging by the deviation of evaluation parameters from the reference (Merkuriev, 2002).

Planned course learning outcomes:

- Knowledge of technical processes, circuits, power engineering equipment, understanding of technical processes, knowledge of operational code for electrical installations, knowledge of electrical safety rules, obtaining skills of power management of electrical power network.
- To shape professional competences and learning motivation it is offered to use business game as an active teaching technique, which is an efficient tool to prepare students for future professional activity. Business game, as a tool for simulating various aspects of professional environment and real industrial processes, allows training students for applying the obtained theoretical knowledge and solve problems emerging in their professional activity.
- To solve the optimization problems of electric power plants and systems as applied to all the stages of energy production, decision making, long-term and short-term planning, performance updating, and real-time control.

4. Conclusion

Thus, using LMS Moodle to develop electronic courses enables us to present educational materials in various forms using multimedia, evaluate the quality of training by means of tests and monitoring tools as well as take into account the individual learning styles of students while managing the classroom and independent work. Students' learning motivation soars when they see that the content of the disciplines is connected with their future professional activity. In a virtual environment, students can access all the materials, which makes it possible to effectively organize their self-study work. An electronic course allows helping students acquire and systematize theoretical knowledge, combining different educational technologies, controlling the training quality and implementing the individual approach. Operator training simulators bring the training process more in line with the conditions of the students' future professional activity.

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